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U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Radiation Programs

INTERNATIONAL NUMERICAL MULTIPLE AND SUBMULTIPLE PREFIXES

Multiples and submultiples	Prefixes	Symbols	Pronunciations
10^{12}	tera	T	tĕr'a
10^{9}	giga	G	ji'ga
10^{6}	mega	M	mĕg'a
10^{3}	kilo	k	ki'lo
10^{2}	hecto	h	hĕk'to
10	deka	da	dĕk'a
10^{-1}	deci	d	dĕs'i
10^{-2}	centi	c	sĕn'ti
10^{-3}	milli	m	mil'i
10^{-6}	micro	μ	mi'kro
10^{-9}	nano	n	năn'o
10^{-12}	pico	p	pē'ko
10^{-15}	femto	f	fĕm'to
10^{-18}	atto	a	ăt'to

SYMBOLS, UNITS, AND EQUIVALENTS

Symbol	Unit	Equivalent
Å	angstrom	10^{-10} meter
A	ampere(s)	
a	annum, year	
BeV	billion electron volts	GeV
Ci	curie	3.7×10^{10} dps-2.22×10^{12} dpm
cpm	counts per minute	
dpm	disintegrations per minute	
dps	disintegrations per second	
eV	electron volt	1.6×10^{-12} ergs
g	gram(s)	3.527×10^{-2} ounces= 2.205×10^{-3} pounds
Hz	herts	cycle per second
kVp	kilovolt peak	
m	meter(s)	39.4 inches
m^3	cubic meter(s)	
mCi/mi^2	millicuries per square mile	0.386 nCi/m^2 (mCi/km^2)
mi	mile(s)	
ml	milliliter(s)	
nCi/m^2	nanocuries per square meter	2.59 mCi/mi^2
R	roentgen	
rad	unit of absorbed radiation dose	100 ergs/g
s	second	
yr	year	

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RADIATION DATA AND REPORTS

Volume 15, Number 1, January 1974

Radiation Data and Reports, a monthly publication of the Environmental Protection Agency, presents data and reports provided by Federal, State, and foreign governmental agencies, and other cooperating organizations. Pertinent original data and interpretive manuscripts are invited from investigators.

In August 1959, the President directed the Secretary of Health, Education, and Welfare to intensify Departmental activities in the field of radiological health. The Department was assigned responsibility within the Executive Branch for the collation, analysis, and interpretation of data on environmental radiation levels. This responsibility was delegated to the Bureau of Radiological Health, Public Health Service. Pursuant to the Reorganization Plan No. 3 of 1970, effective December 2, 1970, this responsibility was transferred to the Radiation Office of the Environmental Protection Agency which was established by this reorganization.

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Department of Agriculture
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Department of Health, Education, and Welfare
Environmental Protection Agency
Atomic Energy Commission

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U.S. ENVIRONMENTAL PROTECTION AGENCY

Russell E. Train, Administrator

SECTION I. MILK AND FOOD

Milk Surveillance, September 1973

Although milk is only one of the sources of dietary intake of environmental radioactivity, it is the food item that is most useful as an indicator of the general population's intake of radionuclide contaminants resulting from environmental releases. Fresh milk is consumed by a large segment of the population and contains several of the biologically important radionuclides that may be released to the environment from nuclear activities. In addition, milk is produced and consumed on a regular basis, is convenient to handle and analyze, and samples representative of general population consumption readily can be obtained. Therefore, milk sampling networks have been found to be an effective mechanism for obtaining information on current radionuclide concentrations and long-term trends. From such information, public health agencies can determine the need for further investigation or corrective public health action.

The Pasteurized Milk Network (PMN) sponsored by the Office of Radiation Programs, Environmental Protection Agency, and the Office of Food Sanitation, Food and Drug Administration, Public Health Service, consists of 63 sampling stations: 61 located in the United States, one in Puerto Rico, and one in the Canal Zone. Many of the State health departments also conduct local milk surveillance programs which provide more comprehensive coverage within the individual State. Data from 15 of these State networks are reported routinely in *Radiation Data and Reports*. Additional networks for the routine surveillance of radioactivity in milk in the Western Hemisphere and their sponsoring organizations are:

Pan American Milk Sampling Program (Pan American Health Organization and U.S. Environmental Protection Agency)—5 sampling stations.

Canadian Milk Network (Radiation Protection Division, Canadian Department of National Health and Welfare)—16 sampling stations.

The sampling locations that make up the networks reporting presently in *Radiation Data and Reports* are shown in figure 1. Based on the similar purpose for these sampling activities, the present format integrates the complementary data that are routinely obtained by these several milk networks.

Radionuclide and element coverage

Considerable experience has established that relatively few of the many radionuclides that are formed as a result of nuclear fission become incorporated in milk (*1*). Most of the possible radiocontaminants are eliminated by the selective metabolism of the cow, which restricts gastrointestinal uptake and secretion into the milk. The five fission-product radionuclides which commonly occur in milk are strontium-89, strontium-90, iodine-131, cesium-137, and barium-140. A sixth radionuclide, potassium-40, occurs naturally in 0.0118 percent (*2*) abundance of the element potassium, resulting in a specific activity for potassium-40 of 830 pCi/g total potassium.

Two stable elements which are found in milk, calcium and potassium, have been used as a means for assessing the biological behavior of

HAWAII
LEGEND:
Canadian Sampling Stations
Pasteurized Milk Network Sampling Stations
Pan American Milk Sampling Program Stations
States Presently Reported
0 200 400 600 800 1000 Miles
0 300 600 900 1200 Kilometers

Figure 1. Milk sampling networks in the Western Hemisphere

metabolically similar radionuclides (radiostrontium and radiocesium, respectively). The contents of both calcium and potassium in milk have been measured extensively and are relatively constant. Appropriate values and their variations, expressed in terms of 2 standard deviations (2σ) for these elements are 1.16 ± 0.08 g/liter for calcium and 1.51 ± 0.21 g/liter for potassium. These figures are averages of data from the PMN for May 1963–March 1966 (*3*) and are used for general radiation calculations.

Accuracy of data from various milk networks

In order to combine data from the international, national, and State networks considered in this report, first it was necessary to determine the accuracy with which each laboratory is making its determinations and the agreement of the measurements among the laboratories. The Analytical Quality Control Service of the Office of Radiation Programs conducts periodic studies to assess the accuracy of determinations of radionuclides in milk performed by interested radiochemical laboratories. The generalized procedure for making such a study has been previously outlined (*4*).

The most recent study was conducted during June 1972 with 37 laboratories participating in an experiment on a milk sample containing known concentrations of iodine-131, cesium-137, strontium-89, and strontium-90 (*5*). Of the 18 laboratories producing data for the network reported in *Radiation Data and Reports*, 14 participated in the study.

The accuracy results of this study for these 14 laboratories are shown in table 1. The accuracy of the cesium-137 measurements continues to be excellent as in previous experiments. However, both accuracy and precision need to be improved for iodine-131, strontium-89, and strontium-90 which could probably be accomplished through recalibration.

Development of a common reporting basis

Since the various networks collect and analyze samples differently, a complete understanding of several parameters is useful for interpreting the data. Therefore, the various milk surveillance networks that report regularly were surveyed for information on analytical methods, sampling and analysis frequencies, and estimated analytical errors associated with the data.

In general, radiostrontium is collected by an ion-exchange technique and determined by beta-particle counting in low-background detectors, and the gamma-ray emitters (potassium-40, iodine-131, cesium-137, and barium-140) are determined by gamma-ray spectroscopy of whole milk. Each laboratory has its own modifications and refinements of these basic methodologies.

Many networks collect and analyze samples on a monthly basis. Some collect samples more frequently but composite the several samples

Table 1. Distribution of mean results, quality control experiment

Isotope and known concentration	Number of laboratories in each category				Experimental 2σ error (pCi/liter)
	Acceptable[a]	Warning level[b]	Unacceptable[c]	Total	
Iodine-131: (96 or 99 pCi/liter)	7 (58%)	1 (8%)	4 (33%)	12	6
(438 or 484 pCi/liter)	11 (85%)	0	2 (15%)	13	25 or 28
Cesium-137: (53 or 54 pCi/liter)	11 (92%)	0	1 (8%)	12	6
(295 or 303 pCi/liter)	11 (85%)	2 (15%)	0	13	17
Strontium-89: (29 or 30 pCi/liter)	9 (82%)	0	2 (18%)	11	6
(197 or 201 pCi/liter)	3 (33%)	1 (11%)	5 (56%)	9	11 or 12
Strontium-90: (32.1 or 32.4 pCi/liter)	4 (33%)	4 (33%)	4 (33%)	12	1.9
(150.5 or 151.2 pCi/liter)	6 (55%)	0	5 (45%)	11	8.7

[a] Measured concentration equal to or within 2σ of the known concentration.
[b] Measured concentration outside 2σ and equal to or within 3σ of the known concentration.
[c] Measured concentration outside 3σ of the known concentration.

for one analysis, while others carry out their analyses more often than one a month. Many networks are analyzing composite samples on a quarterly basis for certain nuclides. The frequency of collection and analysis varies not only among the networks but also at different stations within some of the networks. In addition, the frequency of collection and analysis is a function of current environmental levels. The number of samples analyzed at a particular sampling station under current conditions is reflected in the data presentation. Current levels for strontium-90 and cesium-137 are relatively stable over short periods of time, and sampling frequency is not critical. For the short-lived radionuclides, particularly iodine-131, the frequency of analysis is critical and generally is increased at the first measurement or recognition of a new influx of this radionuclide.

The data in table 2 show whether raw or pasteurized milk was collected. An analysis (*6*) of raw and pasteurized milk samples collected during January 1964 to June 1966 indicated that for relatively similar milkshed or sampling areas, the differences in concentration of radionuclides in raw and pasteurized milk are not statistically significant (*6*). Particular attention was paid to strontium-90 and cesium-137 in that analysis.

Practical reporting levels were developed by the participating networks, most often based on 2-standard-deviation counting errors or 2-standard-deviation total analytical errors from replicate analyses (*3*). The practical reporting level reflects analytical factors other than statistical radioactivity counting variations and will be used as a practical basis for reporting data.

The following practical reporting levels have been selected for use by all networks whose practical reporting levels were given as equal to or less than the given value.

Radionuclide	Practical reporting level (pCi/liter)
Strontium-89	5
Strontium-90	2
Iodine-131	10
Cesium-137	10
Barium-140	10

Some of the networks gave practical reporting levels greater than those above. In these cases, the larger value is used so that only data considered by the network as meaningful will be presented. The practical reporting levels apply to the handling of individual sample determinations. The treatment of measurements equal to or below those practical reporting levels for calculation purposes, particularly in calculating monthly averages, is discussed in the data presentation.

Analytical error of precision expressed as pCi/liter or percent in a given concentration range also has been reported by the networks (*3*). The precision errors reported for each of the radionuclides fall in the following ranges:

Radionuclide	Analytical errors of precision (2-standard deviations)
Strontium-89	1–5 pCi/liter for levels <50 pCi/liter;
	5–10% for levels ≥50 pCi/liter;
Strontium-90	1–2 pCi/liter for levels <20 pCi/liter;
	4–10% for levels ≥20 pCi/liter;
Iodine-131, Cesium-137, Barium-140	4–10 pCi/liter for levels <100 pCi/liter;
	4–10% for levels ≥100 pCi/liter.

For iodine-131, cesium-137, and barium-140, there is one exception for these precision error ranges: 25 pCi/liter at levels<100 pCi/liter for Colorado. This is reflected in the practical reporting level for the Colorado milk network.

Federal Radiation Council guidance applicable to milk surveillance

In order to place the United States data on radioactivity in milk in perspective, a summary of the guidance provided by the Federal Radiation Council for specific environmental conditions was presented in the February 1973 issue of *Radiation Data and Reports.*

Data reporting format

Table 2 presents the integrated results of the international, national, and State networks discussed earlier. Column 1 lists all the stations

Table 2. Concentrations of radionuclides in milk for September 1973 and 12-month period, October 1972 through September 1973

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
UNITED STATES:						
Ala:	Montgomery [c]	P	NA	5	0	5
Alaska:	Palmer [c]	P	NA	4	0	1
Ariz:	Phoenix [c]	P	NA	0	0	0
Ark:	Little Rock [c]	P	NA	10	0	2
Calif:	Los Angeles [c]	P	NA	0	0	0
	Sacramento [c]	P	NA	1	0	0
	San Francisco [c]	P	NA	0	0	0
	Del Norte	P	10	10	0	7
	Fresno	P	0	1	0	2
	Humboldt	P	0	3	0	1
	Los Angeles	P	0	1	0	1
	Mendocino	P	2	2	0	3
	Sacramento	P	0	2	0	3
	San Diego	P	0	1	0	2
	Santa Clara	P	0	2	0	2
	Shasta	P	0	2	0	3
	Sonoma	P	0	2	0	2
Colo:	Denver [c]	P	NA	2	0	0
	East	R	NS	NA	NS	14
	Northeast	R	NS	NA	NS	0
	Northwest	R	NS	NA	NS	3
	South Central	R	NS	NA	NS	NS
	Southeast	R	NS	NA	NS	0
	Southwest	R	NS	NA	NS	2
	West	R	NS	NA	NS	0
Conn:	Hartford [c]	P	NA	4	0	4
	Central	P	NA		NA	
Del:	Wilmington [c]	P	NA	6	0	3
D.C:	Washington [c]	P	NA	4	0	1
Fla:	Tampa [c]	P	NA	4	29	30
	Central	R	7	5	23	29
	North	R	NA	7	10	12
	Northeast	R	5	6	33	32
	Southeast	R	7	5	49	46
	Tampa Bay area	P	4	5	27	29
	West	R	8	8	14	9
Ga:	Atlanta [c]	P	NA	4	0	6
Hawaii:	Honolulu [c]	P	NA	1	0	0
Idaho:	Idaho Falls [c]	P	NA	3	0	0
Ill:	Chicago [c]	P	NA	5	0	2
Ind:	Indianapolis [c]	P	NA	5	0	3
	Central	P	5	6	0	8
	Northeast	P	6	5	0	9
	Northwest	P	7	7	0	8
	Southeast	P	6	6	0	6
	Southwest	P	8	7	0	9
Iowa:	Des Moines [c]	P	NA	5	0	0
	Des Moines	P	4 (3)	5	0 (3)	0
	Iowa City	P	7	5	0	0
	LeMars	P	NS	4	NS	2
	Little Cedar	P	NS	7	NS	0
Kans:	Wichita [c]	P	NA	5	0	0
	Coffeyville	P	7	8	0	7
	Dodge City	P	6	5	0	6
	Falls City, Nebr	R	8	7	0	5
	Hays	P	6	7	0	5
	Kansas City	P	6	6	0	7
	Topeka	P	5	7	0	6
	Wichita	P	6	7	0	6
Ky:	Louisville [c]	P	NA	5	0	1
La:	New Orleans [c]	P	NS	8	NS	1
Maine:	Portland [c]	P	NA	6	18	19
Md:	Baltimore [c]	P	NA	6	0	5
Mass:	Boston [c]	P	NA	6	0	14
Mich:	Detroit [c]	P	NA	6	0	2
	Grand Rapids [c]	P	NA	8	0	1
	Bay City	P	NS	7	NS	0
	Charlevoix	P	4	6	3 (4)	3
	Detroit	P	7	5	0	0
	Grand Rapids	P	10	6	12	3
	Lansing	P	11	7	0 (2)	3
	Marquette	P	8	8	7 (2)	9
	Monroe	P	19	7	0	0
	South Haven	P	16	8	0 (4)	3
Minn:	Minneapolis [c]	P	NA	7	0	3
	Bemidji	P	7	7	0	13
	Duluth	P	16	16	14	19
	Fergus Falls	P	3	6	0	0
	Little Falls	P	20	17	32	27
	Mankato	P	5	4	0	0
	Marshall	P	3	4	0	0

See footnotes at end of table.

Table 2. Concentrations of radionuclides in milk for September 1973 and 12-month period, October 1972 through September 1973—continued

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
Minn:	Minneapolis	P	11	9	0	0
	Rochester	P	7	7	0	0
Miss:	Jackson [c]	P	NA	8	0	7
Mo:	Kansas City [c]	P	NA	4	0	0
	St. Louis [c]	P	NA	6	0	1
Mont:	Helena [c]	P	NA	2	0	0
Nebr:	Omaha [c]	P	NA	3	0	0
Nev:	Las Vegas [c]	P	NA	3	0	0
N.H:	Manchester [c]	P	NA	7	0	8
N.J:	Trenton [c]	P	NA	6	0	3
N. Mex:	Albuquerque [c]	P	NS	0	NS	0
N.Y:	Buffalo [c]	P	NA	5	0	3
	New York City [c]	P	NA	6	0	4
	Syracuse [c]	P	NA	6	0	2
	Albany	P	4	4	0	0
	Buffalo	P	4	5	0	0
	Massena	P	NA	5	0	0
	New York City	P	8	7	0	0
	Syracuse	P	NA	5	0	0
N.C:	Charlotte [c]	P	NA	7	14	6
N. Dak:	Minot [c]	P	NA	7	0	0
Ohio:	Cincinnati [c]	P	NA	5	0	2
	Cleveland [c]	P	NA	6	0	2
Okla:	Oklahoma City [c]	P	NA	3	0	0
Oreg:	Portland [c]	P	NA	4	0	1
	Baker	P	NA		NA	
	Coos Bay	P	NA		NA	
	Eugene	P	NA		NA	
	Medford	P	NA		NA	
	Portland composite	P	NA		NA	
	Portland local	P	NA		NA	
	Redmond	P	NA		NA	
	Tillamook	P	NA		NA	
Pa:	Philadelphia [c]	P	NA	5	0	2
	Pittsburgh [c]	P	NA	8	0	5
	Dauphin	P	6	4	0	1
	Erie	P	6	6	0	0
	Philadelphia	P	4	4	0	2
	Pittsburgh	P	8	6	0	1
R.I:	Providence [c]	P	NA	5	0	6
S.C:	Charleston [c]	P	NA	6	0	7
	Chapin	R	8	8	12	12
	Clemson	R	NS	7	NS	6
	Columbia	R	NS	7	NS	10
	Fairfield	R	6	7	18	14
	Hartsville-02	R	NS	7	NS	12
	Hartsville-03	R	NS	17	NS	16
	Lee County	R	NS	8	NS	17
	Oconee County	R	NS	8	NS	7
	Pickens	R	NS	7	NS	5
	Williston	R	NS	7	NS	14
	Winnsboro	R	7	8	12	16
S. Dak:	Rapid City [c]	P	NA	5	0	1
Tenn:	Chattanooga [c]	P	NA	6	0	4
	Knoxville [c]	P	NA	NA	0	0
	Memphis [c]	P	NA	6	0	2
	Chattanooga	P	7	7	0	4
	Clinton	R	9	6	0 (2)	5
	Fayetteville	R	NS	7	NS	5
	Kingston	R	10	7	0	0
	Knoxville	P	7	5	0 (2)	2
	Lawrenceburg	R	NS	6	NS	4
	Nashville	P	NS	5	NS	2
	Pulaski	R	7	6	0 (2)	0
	Sequoyah	R	NS	8	NS	0
Tex:	Austin [c]	P	NA	0	0	0
	Dallas [c]	P	NA	4	0	0
	Amarillo	R	NA		NA	
	Corpus Christi	R	NA		NA	
	El Paso	R	NA		NA	
	Fort Worth	R	NA		NA	
	Harlingen	R	NA		NA	
	Houston	R	NA		NA	
	Lubbock	R	NA		NA	
	Midland	R	NA		NA	
	San Antonio	R	NA		NA	
	Texarkana	R	NA		NA	
	Uvalde	R	NA		NA	
	Wichita Falls	R	NA		NA	
Utah:	Salt Lake City [c]	P	NA	3	0	1
Vt:	Burlington [c]	P	NA	5	0	7
Va:	Norfolk [c]	P	NA	5	0	3
Wash:	Seattle [c]	P	NA	2	0	0
	Spokane [c]	P	NA	4	0	0

See footnotes at end of table.

Table 2. Concentrations of radionuclides in milk for September 1973 and 12-month period, October 1972 through September 1973—continued

Sampling location		Type of sample [a]	Radionuclide concentration (pCi/liter)			
			Strontium-90		Cesium-137	
			Monthly average [b]	12-month average	Monthly average [b]	12-month average
Wash:	Benton County	R	0	1	0	0
	Franklin County	R	NS	1	NS	0
	Longview	R	3	3	0	2
	Sandpoint, Idaho	R	4	5	0	1
	Skagit County	R	3	5	0	1
W. Va:	Charleston [c]	P	NA	6	0	3
Wisc:	Milwaukee [c]	P	NA	5	0	2
Wyo:	Laramie [c]	P	NA	1	0	1
CANADA:						
Alberta:	Calgary	P	4	5	11	9
	Edmonton	P	5	5	0	13
British Columbia:	Vancouver	P	5	6	14	14
Manitoba:	Winnipeg	P	4	5	NS	
New Brunswick:	Moncton	P	7	7	11	9
Newfoundland:	St. John's	P	21	14	NS	
Nova Scotia:	Halifax	P	8	7	8	11
Ontario:	Ottawa	P	2	5	5	6
	Sault Ste. Marie	P	8	9	18	17
	Thunder Bay	P	4	7	NS	
	Toronto	P	3	3	NS	
	Windsor	P	2	2	4	6
Quebec:	Montreal	P	5	5	NS	
	Quebec	P	7	8	12	14
Saskatchewan:	Regina	P	3	5	5	8
	Saskatoon	P	6	6	NS	
CENTRAL AND SOUTH AMERICA:						
Canal Zone:	Cristobal [c]	P	NS	0	NS	8
Chile:	Santiago	P	0	1	0	1
Colombia:	Bogota	P	0	1	0	0
Ecuador:	Guayaquil	P	0	1	0	0
Jamaica:	Montego Bay	P	NS	3	NS	25
Puerto Rico:	San Juan [c]	P	NA	1	0	2
Venezuela:	Caracas	P	0	1	0	2
PMN network average [d]			0	4	1	3

[a] P, pasteurized milk.
R, raw milk.

[b] When an individual sampling result was equal to or less than the practical reporting level, a value of "0" was used for averaging. Monthly averages less than the practical reporting level reflect the fact that some but not all of the individual samples making up the average contained levels greater than the practical reporting level. When more than one analysis was made in a month period, the number of samples in the monthly average is given in parentheses.

[c] Pasteurized Milk Network station. All other sampling locations are part of the State or National network.

[d] This entry gives the average radionuclide concentrations for the Pasteurized Milk Network stations denoted by footnote [c].
NA, no analysis.
NS, no sample collected.

which are reported routinely in *Radiation Data and Reports*. The relationship between the PMN stations and the State stations is shown in figure 2. The first column in table 2 under each of the reported radionuclides gives the monthly average for the station and the number of samples analyzed in that month in parentheses. When an individual sampling result is equal to or below the practical reporting level for the radionuclide, a value of zero is used for averaging. Monthly averages are calculated using the above convention. Averages which are equal to or less than the practical reporting levels reflect the presence of radioactivity in some of the individual samples greater than the practical reporting level.

The second column under each of the radionuclides reported gives the 12-month average for the station as calculated from the preceding 12 monthly averages, giving each monthly average equal weight. Since the daily intake of radioactivity by exposed population groups, averaged over a year, constitutes an appropriate criterion for the case where the FRC radiation protection guides apply, the 12-month average serves as a basis for comparison.

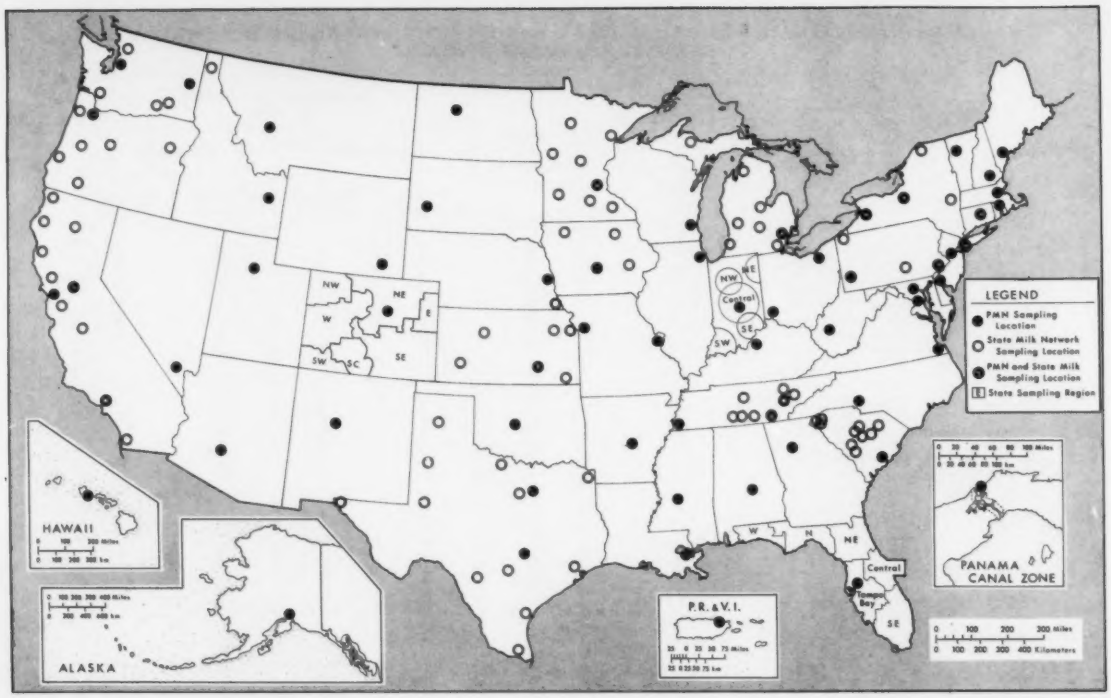

Figure 2. State and PMN milk sampling stations in the United States

Discussion of current data

In table 2, surveillance results are given for strontium-90 and cesium-137 for September 1973 and the 12-month period, October 1972 to September 1973. Except where noted, the monthly average represents a single sample for the sampling station. Strontium-89, iodine-131, and barium-140 data have been omitted from table 2 since levels at all of the stations for September 1973 were below the respective practical reporting level, except for strontium-89 at Guayaquil which was 6 pCi/liter and at Bogota, which was 7 pCi/liter.

Strontium-90 monthly averages ranged from 0 to 20 pCi/liter in the United States for September 1973 and the highest 12-month average was 17 pCi/liter (Little Falls, Minn. and Hartsville–03, S.C.) representing 8.5 percent of the Federal Radiation Council radiation protection guide. Cesium-137 monthly averages ranged from 0 to 49 pCi/liter in the United States for September 1973, and the highest 12-month average was 46 pCi/liter (Southeast Florida) representing 1.3 percent of the value derived from the recommendations given in the Federal Radiation Council report.

The Office of Radiation Programs is in the process of modifying the milk program to make it more responsive to potential sources of environmental radioactivity. These changes will be reflected in future articles.

Acknowledgement

Appreciation is expressed to the personnel of the following agencies who provide data from from their milk surveillance networks:

Radiologic Health Section
Environmental Control Component
California Department of Health

Radiation Protection Bureau
Canadian Department of National Health and Welfare

Radiological Health Section
Division of Occupational and Radiological Health
Colorado Department of Health

Laboratory Division
Connecticut Department of Health

Radiological and Occupational Health Section
Department of Health and Rehabilitative Services
State of Florida

Bureau of Environmental Sanitation
Division of Sanitary Engineering
Indiana State Board of Health

Division of Radiological Health
Environmental Engineering Services
Iowa State Department of Health

Radiation Control Section
Environmental Health Division
Kansas State Department of Health

Radiological Health Services
Division of Occupational Health
Michigan Department of Health

Radiation Control Section
Division of Environmental Health
State of Minnesota Department of Health

Bureau of Radiological Pollution Control
New York State Department of Environmental Conservation

Environmental Radiation Surveillance Program
Division of Sanitation and Engineering
Oregon State Board of Health

Radiological Health Section
Bureau of Environmental Health
Pennsylvania Department of Public Health

Division of Radiological Health
South Carolina Department of Health and Environmental Control

Radiological Health Services
Division of Preventable Diseases
Tennessee Department of Public Health

Division of Occupational Health
Environmental Health Services
Texas State Department of Health

Radiation Control Unit
Health Services Division
Washington Department of Social and Health Services

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(*1*) CAMPBELL, J. E., G. K. MURTHY, A. S. GOLDIN, H. B. ROBINSON, C. P. STRAUB, F. J. WEBER, and K. H. LEWIS. The occurrence of strontium-90, iodine-131, and other radionuclides in milk, May 1957 through April 1958. Amer J Pub Health 49:225 (February 1969).

(*2*) U.S. ATOMIC ENERGY COMMISSION, DIVISION OF ISOTOPES DEVELOPMENT. Chart of the Nuclides, Tenth Edition revised to December 1968. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

(*3*) NATIONAL CENTER FOR RADIOLOGICAL HEALTH. Section I. Milk Surveillance. Radiol Health Data Rep 9:730–746 (December 1968).

(*4*) ROSENSTEIN, M. and A. S. GOLDIN. Statistical technics for quality control of environmental radioassay. Health Lab Sci 2:93 (April 1965).

(*5*) BARATTA, E. J. and F. E. KNOWLES, JR. Interlaboratory study of iodine-131, cesium-137, strontium-89, and strontium-90 measurements in milk, June 1972, Technical experiment 72 MKAQ–1. Analytical Quality Control Service, Office of Radiation Programs, EPA, Washington, D. C. 20460 (December 1972).

(*6*) ROBINSON, P. B. A comparison of results between the Public Health Service Raw Milk and Pasteurized Milk Networks for January 1964 through June 1966. Radiol Health Data Rep 9:475–488 (September 1968).

Milk Surveillance Network, September 1973

National Environmental Research Center-
Las Vegas
Environmental Protection Agency

The Milk Surveillance Network,[1] operated by the National Environmental Research Center-Las Vegas (NERC-LV) consists of 24 routine and 2 alternate sampling locations (figure 1) situated in the offsite area surrounding the Nevada Test Site (NTS). This routine network is operated in support of the nuclear testing sponsored by the U.S. Atomic Energy Commission (AEC) at the Nevada Test Site.

In the event of a release of radioactivity from the NTS, special sampling within the affected

[1] This network is operated under a Memorandum of Understanding (No. AT(26–1)–539) with the Nevada Operations Office, U.S. AEC, Las Vegas. Nev.

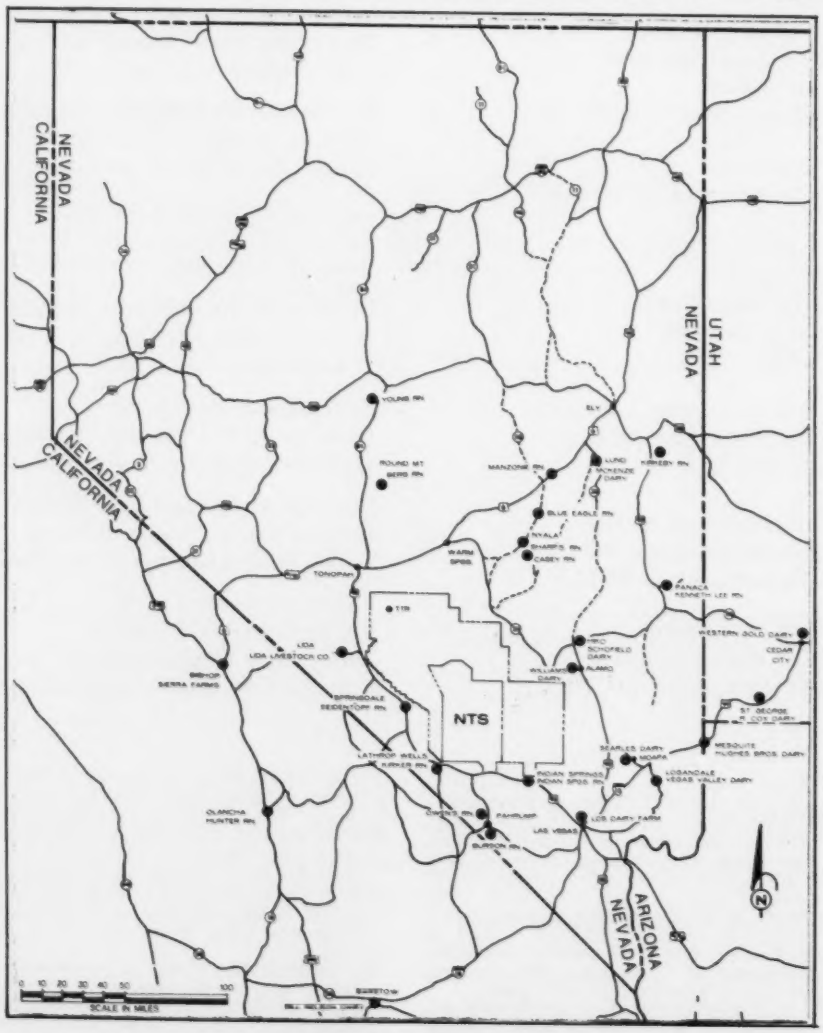

Figure 1. NERC-LV Milk Surveillance Network

areas is conducted to determine radionuclide concentrations. Additional milk sampling networks are operated in support of AEC operations in areas other than the NTS when requested. A complete description of sampling and analytical procedures was included with the milk results reported in the July 1973 issue of *Radiation Data and Reports.*

Results

The analytical results of all milk samples collected in September 1973 by NERC-LV surveillance programs are listed in table 1. With the exception of cesium-137 at levels near the minimum detectable activity (MDA) of 10 pCi/liter, no gamma emitting fission products were identified by gamma spectrometry in any of the samples collected in September. Levels of tritium near the MDA for this radionuclide (~200 pCi/liter) were also measured by liquid scintillation counting techniques. The highest concentration of tritium during September was 1 000 ± 390 pCi/liter.

Table 1. Milk surveillance results, September 1973

Location	Date collected (1973)	Sample type [a]	Radionuclide concentrations [b] (pCi/liter)			
			Cesium-137	Strontium-89	Strontium-90	Tritium
California:						
Bishop:						
Sierra Creamery	19	11	<10	NA	NA	NA
Hinkley:						
Bill Nelson Dairy	17	12	<10	NA	NA	NA
Olancha:						
Hunter Ranch	NS					
Nevada:						
Alamo:						
Williams Dairy	4	12	<10	NA	NA	NA
Austin:						
Young's Ranch	11	13	<10	NA	NA	1000 ±390
Currant:						
Blue Eagle Ranch	13	13	<10	NA	NA	NA
Manzonie Ranch	11	13	[c] <100	NA	NA	NA
Hiko:						
Schofield Dairy	4	12	<10	NA	NA	320 ±250
Indian Springs:						
Indian Springs Ranch	NS					
Las Vegas:						
LDS Dairy Farms	10	12	<10	NA	NA	<250
Lathrop Wells:						
Kirker Ranch	13	13	<10	NA	NA	NA
Lida:						
Lida Livestock Company	3	13	<10	NA	NA	NA
Logandale:						
Vegas Valley Dairy	11	12	<10	NA	NA	NA
Lund:						
McKenzie Dairy	12	12	<10	NA	NA	<380
Mesquite:						
Hughes Bros. Dairy	11	12	<10	NA	NA	<380
Moapa:						
Searles Dairy	11	12	<10	NA	NA	NA
Nyala:						
Sharp's Ranch	11	13	[c] <100	NA	NA	530 ±380
Pahrump:						
Owens Ranch	12	13	<10	NA	NA	NA
Panaca:						
Kenneth Lee Ranch	6	13	<10	NA	NA	NA
Round Mountain:						
Berg Ranch	11	13	<10	NA	NA	NA
Shoshone:						
Kirkeby Ranch	NS					
Springdale:						
Seidentopf Ranch	13	13	<10	NA	NA	NA
Utah:						
Cedar City:						
Western Gold Dairy	12	12	<10	NA	NA	NA
St. George:						
R. Cox Dairy	11	12	<10	NA	NA	NA

[a] 11—Pasteurized milk.
12—Raw milk from Grade A producer(s).
13—Raw milk from family cow(s).
[b] Two-sigma counting error provided when available.
[c] Small sample size increased minimum detectable activity.
NA, no analysis.
NS, no sample.

Food and Diet Surveillance

Efforts are being made by various Federal and State agencies to estimate the dietary intake of selected radionuclides on a continuing basis. These estimates, along with the guidance developed by the Federal Radiation Council, provide a basis for evaluating the significance of radioactivity in foods and diet.

Networks presently in operation and reported routinely include those listed below. These networks provide data useful for developing estimates of nationwide dietary intakes of radionuclides. Programs reported in *Radiation Data and Reports* are as follows:

Program	Period reported	Issue
California Diet Study	January–June 1971	December 1972
Carbon-14 in Total Diet and Milk	1972–1973	November 1973
Institutional Diet	January–March 1973	November 1973
Strontium-90 in Tri-City Diets	1972	December 1973

SECTION II. WATER

The Environmental Protection Agency and other Federal, State, and local agencies operate extensive water quality sampling and analysis programs for surface, ground, and treated water. Most of these programs include determinations of gross beta and gross alpha radioactivity and specific radionuclides.

Although the determination of the total radionuclide intake from all sources is of primary importance, a measure of the public health importance of radioactivity levels in water can be obtained by comparison of the observed values with the Public Health Service Drinking Water Standards (*1*). These standards, based on consideration of Federal Radiation Council (FRC) recommendations (*2–4*) set the limits for approval of a drinking water supply containing radium-226 and strontium-90 at 3 pCi/liter and 10 pCi/liter, respectively. Higher concentrations may be acceptable if the total intake of radioactivity from all sources remains within the guides recommended by FRC for control action. In the known absence[1] of strontium-90 and alpha-particle emitters, the limit is 1 000 pCi/liter gross beta radioactivity, except when additional analysis indicates that concentrations of radionuclides are not likely to cause exposures greater than the limits indicated by the Radiation Protection Guides. Surveillance data from a number of Federal and State programs are published periodically to show current and long-range trends. Water sampling activities reported in *Radiation Data and Reports* are listed below.

[1] Absence is taken to mean a negligibly small fraction of the specific limits of 3 pCi/liter and 10 pCi/liter for unidentified alpha-particle emitters and strontium-90, respectively.

Water sampling program	Period reported	Issue
California	1971 and 1972	November 1973
Colorado River Basin	1968	March 1972
Community Water Supply Study	1968	September 1972
Florida	1969	January 1972
Interstate Carrier Drinking Water	1971	May 1972
Kansas	1971	February 1973
Minnesota	July 1970–June 1971	November 1972
New York	July–December 1971	August 1973
North Carolina	1968–1970	September 1972
Radiostrontium in Tap Water, *HASL*	January–December 1972	December 1973
Tritium Surveillance System	April–June 1973	October 1973
Washington	July 1970–June 1971	August 1973

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(*2*) FEDERAL RADIATION COUNCIL. Radiation Protection Guidance for Federal Agencies, Memorandum for the President, September 1961. Reprint from the Federal Register of September 26, 1961.

(*3*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 1. Superintendent of Documents, U.S. Government Printing Office, Washington, D. C. 20402 (May 1960).

(*4*) FEDERAL RADIATION COUNCIL. Background material for the development of Radiation Protection Standards, Report No. 2. Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (September 1961).

Water Surveillance Programs,[1] September 1973

National Environmental Research Center-
Las Vegas
Environmental Protection Agency

The Water Surveillance Network, operated by the National Environmental Research Center-Las Vegas (NERC-LV), consists of 59 sampling locations (figures 1 and 2) in the off-site area surrounding the Nevada Test Site (NTS). This routine network is operated in support of the nuclear testing programs sponsored by the U.S. Atomic Energy Commission (AEC) at the Nevada Test Site.

In the event of a release of radioactivity from

[1] This network is operated under a Memorandum of Understanding (No. AT(26-1)-539) with the Nevada Operations Office, U.S. AEC, Las Vegas, Nev.

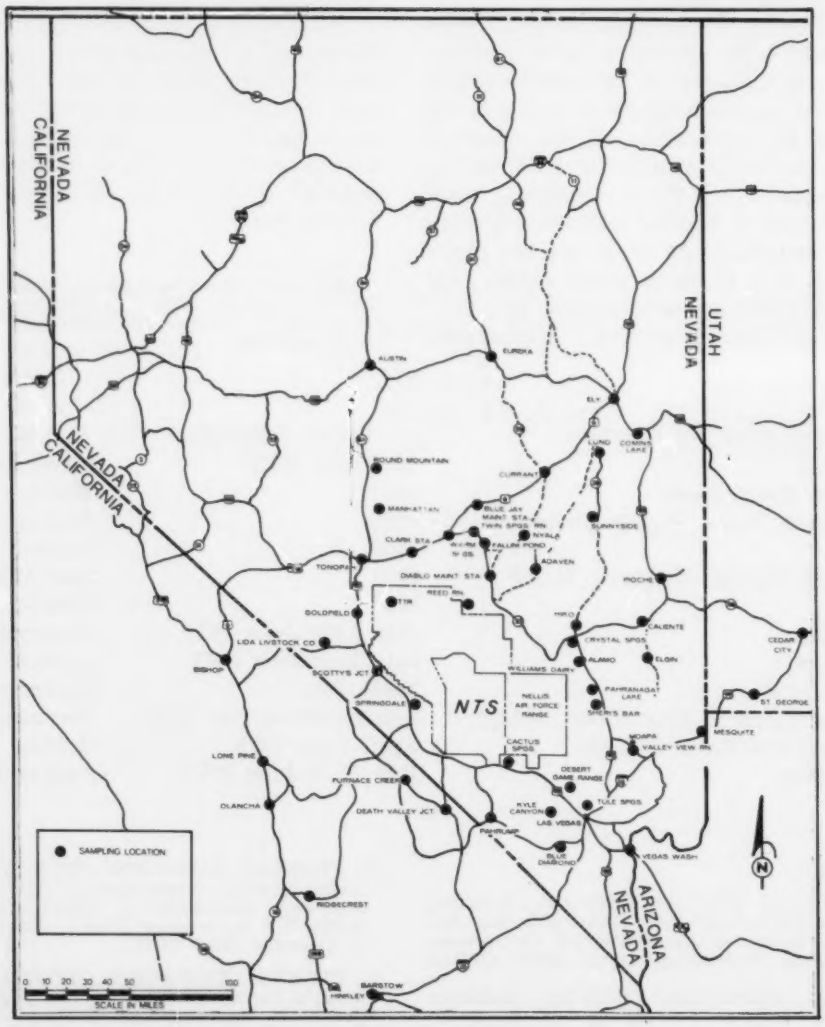

Figure 1. NERC-LV Water Surveillance Network

Table 1. Water surveillance results, September 1973

Location	Date collected (1973)	Sample type[a]	Radionuclide concentrations[b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
California:					
Bishop:					
Fish and Game Office	19	23	<1.5	<3.4	NA
Death Valley Junction:					
Lila's Cafe	14	23	<4.3	5.8±3.7	440±380
Furnace Creek:					
Pond	14	21	<3.7	8.5±3.8	NA
Visitor's Center	14	27	<3.0	6.0±3.6	NA
Hinkley:					
Bill Nelson Dairy	17	23	6.7±5.4	4.9±3.6	NA
Lone Pine:					
Forest Service Ranger Station	18	24	<1.7	<3.4	NA
Olancha:					
Haiwee Reservoir	18	21	6.2±4.0	4.9±3.5	NA
Ridgecrest:					
City Hall	17	23	<2.7	<3.4	NA
Nevada:					
Adaven:					
Canfield Ranch	11	22	3.3±2.9	<3.3	NA
Alamo:					
Pahranagat Lake	4	21	22 ±8.8	24 ±4.8	NA
Sheri's Bar	4	23	<3.0	<3.5	NA
Williams Dairy	4	23	<3.8	12 ±4.1	NA
Austin:					
Nevada National Bank	11	27	19 ±5.7	5.1±3.5	NA
Blue Diamond:					
Post Office	12	23	<2.5	<3.4	<380
Blue Jay Highway:					
Maintenance Station	12	23	<2.9	<3.4	NA
Cactus Springs:					
Mobil Service Station	11	27	<2.0	<3.3	<270
Caliente:					
Agricultural Extension Station	5	23	6.3±4.0	<3.5	NA
Clark Station:					
Five Mile Ranch	12	27	<2.2	6.1±3.6	NA
Currant:					
Currant Ranch Cafe	12	27	5.7±3.8	<3.4	NA
Diablo:					
Highway Maintenance Station	10	23	<2.1	5.2±3.5	NA
Reed Ranch	4	21	28 ±8.4	3.6±3.5	NA
Elgin:					
Water tower	6	23	4.0±2.7	6.4±3.6	NA
Ely:					
Chevron Service Station	13	24	<2.3	<3.4	NA
Comins Lake	13	21	10 ±5.6	27 ±4.7	NA
Eureka:					
Highway Maintenance Station	1	24	5.2±3.9	4.1±3.6	NA
Goldfield:					
Chevron Service Station	4	23	<3.8	<3.6	NA
Hiko:					
Crystal Springs	4	27	5.3±3.7	6.3±3.7	NA
Schofield Dairy	4	23	33 ±9.7	27 ±4.8	NA
Las Vegas:					
Craig Ranch Golf Course	10	23	4.7±3.5	<3.6	<250
Desert Game Range	11	23	2.8±2.6	<3.3	460±270
Lab II NERC	10	24	<4.6	7.1±3.9	730±260
Lake Mead Vegas Wash	10	21	<3.9	4.6±3.7	890±260
Las Vegas Water District Well 28	10	23	2.7±2.6	<3.5	<250
Municipal Golf Course	10	23	2.8±2.6	<3.5	<250
Tule Springs	11	23	<2.2	<3.3	<270
Tule Springs Pond	11	21	<1.9	<3.3	NA
Vegas Estates	10	23	<4.0	8.2±4.0	<250
Lida:					
Lida Livestock Company	4	27	<2.4	<3.5	NA
Pond at storage tank	4	21	<2.8	<3.5	NA
Lund:					
Gardner Grocery	12	23	<2.0	<3.3	NA
Manhattan:					
Country store	11	23	11 ±5.9	6.1±3.5	NA
Mesquite:					
Hughes Bros. Dairy	11	23	<5.7	<3.8	NA
Moapa:					
Pedersen Valley View Ranch	11	27	5.1±4.4	<3.6	NA
Mt. Charleston:					
Kyle Canyon Fire Station	11	27	<2.1	<3.3	270±270
Nyala:					
Sharp's Ranch	11	23	<2.4	<3.4	NA
Pahrump:					
Texaco Service Station	12	23	<1.9	<3.3	NA
Pioche:					
County courthouse	5	24	3.1±2.9	<3.5	NA
Round Mountain:					
Mobil Service Station	11	27	<2.2	<3.3	NA
Scotty's Junction:					
Chevron Service Station	4	23	6.2±5.4	8.6±4.0	390±240

See footnotes at end of table.

Table 1. Water surveillance results, September 1973—continued

Location	Date Collected (1973)	Sample type[a]	Radionuclide concentrations[b] (pCi/liter)		
			Gross alpha	Gross beta	Tritium
Springdale:					
Pond	13	21	<3.0	5.0±3.5	NA
Sunnyside:					
Adam McGill Reservoir	12	21	4.9±3.9	22 ±4.4	NA
Wildlife Management Headquarters	12	27	<2.1	<3.4	NA
Tonopah:					
Jerry's Chevron Station	6	23	<3.0	5.2±3.6	NA
Tonopah Test Range CP-1	5	23	<3.7	<3.5	NA
Warm Springs:					
Fallini's Pond	11	21	4.7±4.4	13 ±3.9	NA
Service Station and Cafe	12	27	18 ±8.6	25 ±4.7	NA
Twin Springs Ranch	11	23	4.1±3.9	8.0±3.7	NA
Utah:					
Cedar City:					
M. D. Baldwin residence	12	24	<2.6	<3.6	NA
St. George:					
R. Cox Dairy	11	24	1.9±1.8	<3.5	NA

[a] 21—Pond, lake, reservoir, stock tank, stock pond; 22—Stream, river, creek; 23—Well; 24—Multiple supply mixed (a water sample consisting of mixed or multiple sources of water such as well and spring); 27—Spring.
[b] Two-sigma counting error provided when available. NA, not analyzed. NS, no sample.

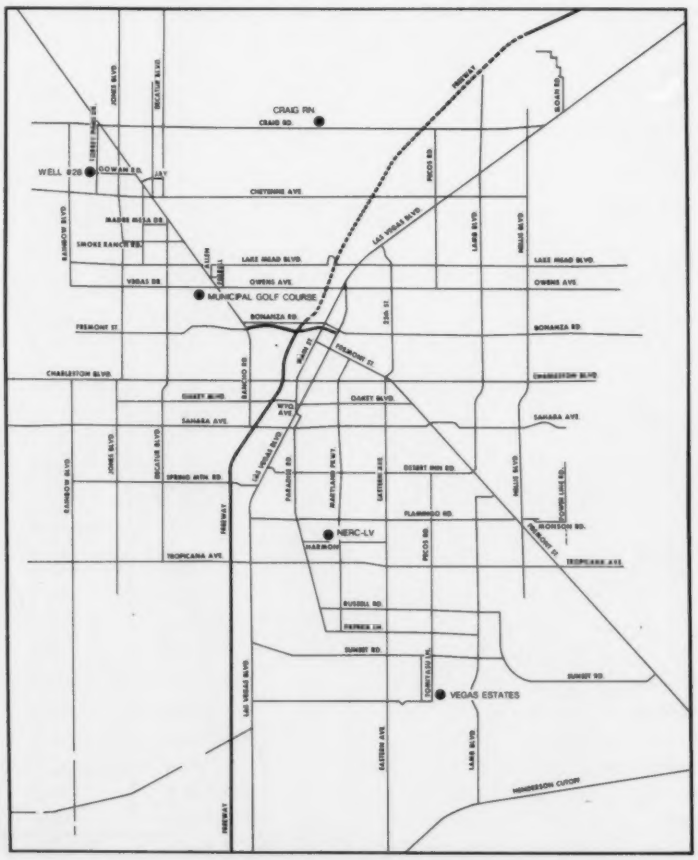

Figure 2. NERC/LV Water Surveillance Network-Las Vegas Valley

Table 2. Special analytical results for water samples collected during 1973

Location	Date collected (1973)	Sample type[a]	Radionuclide concentrations[b] (pCi/liter)							
			^{89}Sr	^{90}Sr	^{226}Ra	^{239}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
California:										
Bishop:										
Fish & Game Office	3/1	23	<2.0	<1.0	0.23±0.090	NA	NA	0.41±0.084	<0.020	0.37±0.076
Death Valley Junction:										
Lila's Cafe	3/1	23	<2.0	<1.0	.22±.10	NA	NA	8.2 ± .31	.051± .020	2.2 ± .16
Furnace Creek:										
Visitor's Center	3/1	27	<2.0	<1.0	.20±.10	NA	NA	3.0 ± .18	.029± .018	1.3 ± .12
Pond	3/1	21	<2.0	<1.0	.16±.080	<0.021	<0.017	2.6 ± .16	.024± .014	1.2 ± .11
Hinkley:										
Bill Nelson Dairy	3/1	23	<2.0	<1.0	.29±.10	NA	NA	5.4 ± .20	.13 ± .030	4.2 ± .17
Lone Pine:										
Forest Service Ranger Sta	3/1	23	<2.0	<1.0	.16 ±.080	NA	NA	.70± .092	.018± .015	.45± .074
Olancha:										
Haiwee Reservoir	3/1	21	<2.0	<1.0	.19±.10	< .028	<.012	4.4 ± .22	.097± .033	3.7 ± .20
Ridgecrest:										
City Hall	3/1	23	<2.0	<1.0	.20±.090	NA	NA	.89± .099	.035± .019	.72± .087
Nevada:										
Adaven:										
Canfield Ranch	4/8	22	<1.0	<.80	.24±.10	NA	NA	3.5 ± .20	.049± .023	1.3 ± .11
Alamo:										
Williams Dairy	3/1	23	<1.0	<.90	.19±.10	NA	NA	8.4 ± .40	.14 ± .051	3.5 ± .26
Pahranagat Lake	3/1	21	<1.0	<.90	.92±.18	<.031	< .046	14 ± .42	.19 ± .049	5.2 ± .25
Sheri's Bar	3/1	23	<1.0	<.80	.17±.090	NA	NA	5.7 ± .32	.067± .035	1.5 ±.16
Ash Meadows:										
Ash Meadows Lodge	4/10	23	<2.0	<1.0	.87±.17	NA	NA	7.2 ± .22	.098± .026	2.4 ± .13
Ash Meadows Pond	4/10	21	<2.0	<1.0	.71±.16	<.039	< .016	25 ± .53	.30 ± .058	8.8 ± .31
Austin:										
Nevada National Bank	2/5	27	NA	NA	.32±.11	NA	NA	NA	NA	NA
	4/9	27	<2.0	<1.0	.40±.13	NA	NA	18 ± .32	.37 ± .055	12 ± .30
Blue Diamond:										
Post Office	2/9	23	<2.0	<1.0	.51±.14	NA	NA	4.2 ± .27	.043± .026	1.4 ± .15
Blue Jay Highway Maintenance Station	4/10	23	<2.0	<1.0	.27±.10	NA	NA	2.9 ± .16	.035± .019	1.1 ± .10
Cactus Springs:										
Mobil Service Station	4/11	27	<2.0	<1.0	.31±.12	NA	NA	1.6 ± .12	.032± .016	.55± .071
Caliente:										
Agricultural Extension Station	3/1	23	<2.0	<.90	.22±.10	NA	NA	13 ± .44	.14 ± .044	3.5 ± .22
Clark Station:										
Five Mile Ranch	4/10	27	<2.0	<1.0	.16±.090	NA	NA	.63± .081	.014± .012	.26± .049
Currant:										
Currant Ranch Cafe	2/7	27	<2.0	<1.0	.18±.10	NA	NA	14 ± .42	.20 ± .050	4.6 ± .24
	3/1	27	NA	NA	.13±.060	NA	NA	NA	NA	NA
Diablo:										
Highway Maintenance Station	4/11	23	<2.0	<1.0	.49±.14	NA	NA	1.6 ± .12	.038± .018	.82± .086
Reed Ranch	4/9	21	<2.0	4.6±1.3	.20±.080	<.036	< .021	19 ± .43	.092± .028	2.4 ± .15
Elgin:										
Water tower	2/7	23	NA	NA	.58±.15	NA	NA	NA	NA	NA
	3/1	23	<1.0	<.90	.67±.16	NA	NA	18 ± .52	.17 ± .049	4.7 ± .26
Ely:										
Chevron Service Station	2/6	24	<2.0	<1.0	.51±.14	NA	NA	4.3 ± .28	.050± .030	.99± .14
Comins Lake	4/16	21	<2.0	<.70	.14±.080	<.61	< .74	NA	NA	NA
	8/13	21	NA	NA	NA	NA	NA	12 ± .36	.24 ± .051	4.3 ± .21
Eureka:										
Highways Maintenance Station	4/2	24	<1.0	<.80	.27±.11	NA	NA	2.1 ± .12	.029± .014	.72± .073
Goldfield:										
Chevron Service Station	4/9	23	<2.0	<1.0	.35±.12	NA	NA	.50± .067	<.0040	.14± .035
Hiko:										
Crystal Springs	3/1	27	<1.0	<.80	.64±.16	<.018	< .016	5.7 ± .26	.043± .021	1.9 ± .15
Schofield Dairy	2/5	23	NA	NA	.38±.12	NA	NA	NA	NA	NA
	3/1	23	<2.0	<1.0	.55±.14	NA	NA	22 ± .41	.34 ± .050	8.2 ± .25
	4/10	23	NA	NA	.33±.10	NA	NA	NA	NA	NA

See footnotes at end of table.

Table 2. Special analytical results for water samples collected during 1973—continued

Location	Date collected (1973)	Sample type[a]	Radionuclide concentrations[b] (pCi/liter)							
			^{89}Sr	^{90}Sr	^{226}Ra	^{238}Pu	^{239}Pu	^{234}U	^{235}U	^{238}U
Las Vegas:										
Desert Game Range	2/9	23	<2.0	<1.0	.27±.11	NA	NA	14 ± .55	.073± .039	2.4 ± .23
Lab II-NERC	2/12	24	<2.0	<1.0	.29±.10	NA	NA	9.0 ± .40	.17 ± .053	4.7 ± .29
Lake Mead Vegas Wash	2/12	21	<2.0	3.1±1.2	.28±.11	<.018	< .020	7.1 ± .40	.17 ± .061	4.5 ± .32
Tule Springs	2/9	23	<2.0	<1.0	.22±.10	NA	NA	6.2 ± .40	.058± .039	1.7 ± .21
Tule Springs Pond	2/9	21	<2.0	<1.1	.34±.11	<.020	.063± .034	7.1 ± .38	.080± .040	2.2 ± .21
Craig Rch Golf Course	3/1	23	<1.0	<.80	.35±.12	NA	NA	3.4 ± .24	.083± .039	1.8 ± .17
Municipal Golf Course	3/1	23	<1.0	<.80	.59±.14	<.016	<.017	<.020	<.010	<.010
Vegas Estates	3/1	23	<2.0	<.90	.18±.090	NA	NA	6.3 ± .34	.078± .037	1.6 ± .17
Las Vegas Water District Well 28	3/1	23	<2.0	<.90	.22±.10	NA	NA	4.4 ± .29	.051± .032	1.2 ± .15
Lida:										
Lida Livestock Company	2/5	27	<2.0	<.90	.31±.10	NA	NA	6.1 ± .32	.058± .030	1.6 ± .16
Pond at storage tank	2/5	21	<2.0	<1.0	.28±.10	<.024	.028± .018	6.1 ± .35	.092± .043	1.6 ± .17
Lund:										
Gardner Grocery	2/8	23	<2.0	<1.0	.25±.10	NA	NA	4.1 ± .24	.076± .031	1.8 ± .16
Manhattan:										
Country store	2/6	23	<2.0	<1.0	.31±.10	NA	NA	29 ± .71	.42 ± .086	11 ± .44
	3/1	23	NA	NA	.18±.070	NA	NA	NA	NA	NA
Mesquite:										
Hughes Bros. Dairy	4/10	23	<2.0	<1.0	.47±.13	NA	NA	3.6 ± .18	.12 ± .032	2.3 ± .15
Moapa:										
Pedersen Valley View Ranch	4/10	27	<2.0	<1.0	.41±.13	NA	NA	.97 ± .097	.019± .014	.35± .059
Mt. Charleston:										
Kyle Canyon Fire Station	2/9	27	<2.0	<1.0	.32±.11	NA	NA	1.7 ± .18	.042± .028	.89± .13
Nyala:										
Sharp's Ranch	4/11	23	<2.0	<1.0	.23±.10	NA	NA	1.5 ± .11	.034± .017	.55± .069
Pahrump:										
Texaco Service Station	4/11	23	<2.0	<1.0	.47±.13	NA	NA	1.4 ± .12	.019± .010	.26± .036
Pioche:										
County Courthouse	3/1	24	<2.0	<1.0	.21±.10	NA	NA	2.8 ± .15	.044± .019	.84± .082
Round Mountain:										
Mobil Service Station	2/6	27	<2.0	<1.0	.28±.10	NA	NA	2.5 ± .20	.082± .036	2.0 ± .10
Scotty's Junction:										
Chevron Service Station	2/5	23	<2.0	<1.5	.71±.49	NA	NA	11 ± .47	.20± .065	4.1 ± .29
Springdale:										
Pond	4/10	21	<2.0	<1.0	.22±.10	<.016	<.018	4.3 ± .21	.027± .017	.95± .095
Sunnyside:										
Wildlife Management Headquarters	2/8	27	<1.0	<1.0	.25±.11	NA	NA	4.8 ± .30	.032± .024	.91± .13
Adam McGill Reservoir	4/17	21	<2.0	<.70	1.6 ±.24	NA	NA	3.5 ± .19	.041± .020	.80± .091
Tonopah:										
Jerry's Chevron Station	2/7	23	<2.0	<1.5	.65±.23	NA	NA	6.5 ± .33	.096± .040	3.0 ± .22
Tonopah Test Range CP-1	2/7	23	<3.0	<1.7	.22±.10	NA	NA	6.8 ± .33	.16 ± .050	3.8 ± .24
Warm Springs:										
Service Station and Cafe	2/5	27	<2.0	<1.3	8.5 ±.53	NA	NA	1.0 ± .13	<.010	.40± .080
Twin Springs Ranch	2/7	23	<3.0	<1.5	<.10	NA	NA	15 ± .19	.18 ± .048	5.4 ± .22
Fallini's Pond	3/1	21	<2.0	<1.0	NA	NA	NA	NA	NA	NA
	4/11	21	<2.0	<1.1	.29±.11	<.031	.047	24 ± .48	.33± .058	9.4 ± .30
Utah:										
Cedar City:										
M. D. Baldwin Residence	4/11	24	<2.0	<1.0	.79±.17	NA	NA	4.7 ± .22	.052± .024	1.5 ± .12
St. George:										
R. Cox Dairy	4/11	24	<2.0	<1.0	.16±.090	NA	NA	3.6 ± .20	.11 ± .036	2.4 ± .16

[a] 21—Pond, lake, reservoir, stock tank, stock pond.
22—Stream, river, creek.
23—Well.
24—Multiple supply-mixed water sample consisting of mixed or multiple sources of water, such as well or spring.
27—Spring.

[b] Two-sigma counting error provided when available.
NA, not analyzed.

the NTS, special sampling within the affected area is conducted to determine radionuclide concentrations. Additional water sampling networks are operated in support of AEC operations in areas other than the NTS when requested. A complete description of sampling and routine analytical procedures was included with the water results reported in the July 1973 issue of *Radiation Data and Reports.*

Results

The routine analytical results of all water samples collected in September 1973 by the NERC-LV water surveillance network are listed in table 1. No gamma-emitting fission products were identified by gamma spectrometry in any of the September 1973 samples. Table 2 shows the results of water samples selected for special analyses during 1973.

SECTION III. AIR AND DEPOSITION

Radioactivity in Airborne Particulates and Precipitation

Continuous surveillance of radioactivity in air and precipitation provides one of the earliest indications of changes in environmental fission product radioactivity. To date, this surveillance has been confined chiefly to gross beta radioanalysis. Although such data are insufficient to assess total human radiation exposure from fallout, they can be used to determine when to modify monitoring in other phases of the environment.

Surveillance data from a number of programs are published monthly and summarized periodically to show current and long-range trends of atmospheric radioactivity in the Western Hemisphere. These include data from activities of the Environmental Protection Agency, the Canadian Department of National Health and Welfare, the Pan American Health Organization, and the California Air Sampling Program.

In addition to those programs presented in this issue, the following programs were covered previously in *Radiation Data and Reports.*

Network	Period	Issue
Fallout in the United States and other areas, *HASL*	1971	August 1973
Mexican Air Monitoring Program	January–June 1973	December 1973
Plutonium in airborne particulates	October–December 1972	June 1973
Surface air sampling program, 80th Meridian Network, *HASL*	1971	September 1973

1. Radiation Alert Network September 1973

Eastern Environmental Radiation Facility
Environmental Protection Agency

Surveillance of atmospheric radioactivity in the United States is conducted by the Radiation Alert Network (RAN) which gathers samples at 68 locations distributed throughout the country (figure 1). Most of the stations are operated by State health department personnel.

The station operators perform "field estimates" on the airborne particulate samples at 5 hours after collection, when most of the radon daughter products have decayed, and at 29 hours after collection, when most of the thoron daughter products have decayed. The airborne particulate samples and precipitation samples are sent to the Eastern Environmental Radiation Facility for further analysis. All field estimate results are reported to appropriate Environmental Protection Agency officials by mail or telephone depending on levels found. A compilation of the daily measurements is available upon request from the Eastern Environmental Radiation Facility, Montgomery, Ala. 36109. A detailed description of the sampling and analytical procedures was presented in the March 1968 issue of *Radiological Health Data and Reports*.

Table 1 presents the monthly average gross beta radioactivity in surface air particulates and deposition by precipitation, as measured by the field estimate and laboratory techniques during September 1973.

The Office of Radiation Programs is in the process of modifying the air program to make it more responsive to potential sources of environmental radioactivity. These changes will be reflected in fuutre articles.

Figure 1. Radiation Alert Network sampling stations

Table 1. Gross beta radioactivity in surface air and precipitation, September 1973

Station location		Number of samples	Gross beta radioactivity (pCi/m³)						Precipitation	
			5-hour field estimate			Laboratory measurement			Laboratory estimate of deposition	
			Maximum	Minimum	Average[a]	Maximum	Minimum	Average[a]	Depth (mm)	Total deposition (nCi/m²)
Ala:	Montgomery	18	3	0	1	0.06	0.01	0.02	87	0.10
Alaska:	Anchorage	3	0	0	0	.02	<.01	.01		
Calif:	Berkeley	7	1	0	0	.03	<.01	.01	15	.04
	Los Angeles	8	1	0	0	.04	.01	.02		
Colo:	Denver	8	3	1	2	.04	.02	.03	83	.96
Del:	Dover	6	0	0	0	.03	.01	.02		
Ind:	Indianapolis	15	2	0	1	.06	<.01	.03		
Nev:	Las Vegas	12	2	0	1	.05	.02	.03		
N.Y:	Buffalo	8	1	0	0	.05	.02	.03		
N. Dak:	Bismarck	8	2	0	1	.03	.01	.02	63	.18
Ohio:	Columbus	8	3	1	1	.04	.02	.03		
Okla:	Oklahoma City	4	1	0	1	.02	.01	.02		
Oreg:	Portland	18	0	0	0	.05	<.01	.02		
Pa:	Harrisburg	18	2	0	1	.03	<.01	.02		
S.C:	Columbia	8	1	0	1	.20	.02	.08	109	.26
Network summary		149	3	0	1	0.20	<0.01	0.03	71	0.31

[a]The monthly average is calculated by weighting the estimates of individual air samples with length of sampling period.

2. Air Surveillance Network, September 1973

National Environmental Research Center-Las Vegas[1]
Environmental Protection Agency

The Air Surveillance Network[2] (ASN), operated by the National Environmental Research Center-Las Vegas (NERC-LV), consists of 49 active and 72 standby sampling stations located in 21 western States (figures 2 and 3). The network is operated in support of nuclear testing sponsored by the Atomic Energy Commission (AEC) at the Nevada Test Site (NTS), and at any other designated testing sites.

The stations are operated by State Health department personnel and by private individuals on a contract basis. All active stations are operated continuously with filters being exchanged over periods generally ranging from 24 to 72 hours. All samples are mailed to the NERC-LV unless special retrieval is arranged at selected locations in response to known releases of radioactivity from the NTS. A complete description of sampling and analytical procedures was presented in the February 1972 issue of *Radiation Data and Reports.*

Results

Table 2 presents the average gross beta concentrations in air for each of the network

[1] Formerly the Western Environmental Research Laboratory.
[2] The ASN is operated under a Memorandum of Understanding (No. AT(26-1)-539) with the Nevada Operations Office, U.S. Atomic Energy Commission.

stations. The minimum reporting concentration for gross beta activity is 0.1 pCi/m³. For reporting purposes, concentrations less than 1.0 pCi/m³ are reported to 1 significant figure, and those equal to or greater than 1.0 pCi/m³ are reported to 2 significant figures. For averaging purposes concentration values less than the minimum detectable concentration (~0.06 pCi/m³ for a 350 m³ sample) are set equal to the minimum detectable concentration (MDC). Reporting and rounding-off conventions are indicated as follows:

Concentration (pCi/m³)	Reported value of concentration above MDC (pCi/m³)	Reported value of concentration below MDC (pCi/m³)
<0.05	<0.1	<0.1
≧0.05 <0.15	0.1	<0.1
≧0.15	As calculated and rounded	<calculated MDC

As shown by table 2, the highest gross beta concentration within the network was 0.3 pCi/m³ at Beatty, Nev. No radionuclides were identified by gamma spectrometry on any filters or charcoal cartridges during September.

The 72 standby stations were activated on September 28 for one week of operation to check equipment and gather background radiation data. Since this activation was near the end of the month, many of the standby stations submitted one sample for the month of September.

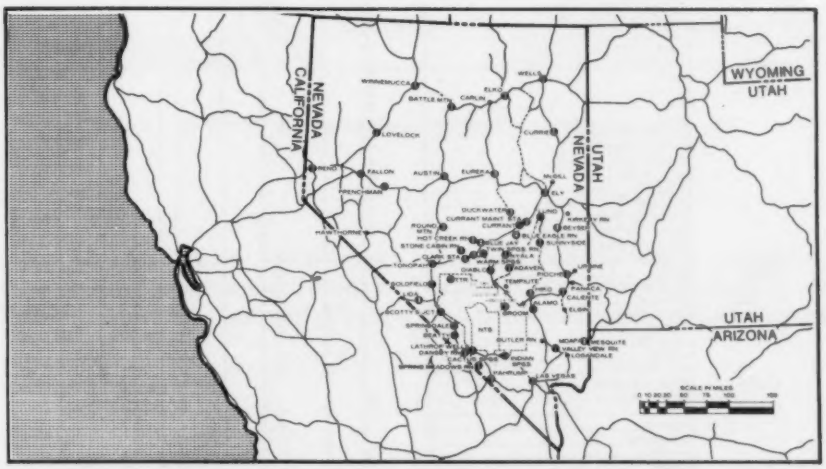

Figure 2. NERC/LV Air Surveillance Network stations in Nevada

Table 2. Summary of gross beta radioactivity concentrations in air, September 1973

Location		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average
Ariz:	Kingman	30	<0.1	<0.1	0.1
	Phoenix	1	.1	.1	.1
	Seligman	30	.1	<.1	.1
	Winslow	1	<.1	<.1	<.1
Ark:	Little Rock	1	<.1	<.1	<.1
Calif:	Baker	25	.1	<.1	.1
	Barstow	29	.1	<.1	.1
	Bishop	30	.1	<.1	.1
	Death Valley Junction	20	.1	<.1	.1
	Furnace Creek	29	.1	<.1	.1
	Indio	1	.1	.1	.1
	Lone Pine	24	<.1	<.1	.1
	Needles	18	.1	<.1	.1
	Ridgecrest	29	<.1	<.1	.1
	Shoshone	30	<.1	<.1	.1
Colo:	Denver	1	<.1	<.1	<.1
	Durango	1	<.1	<.1	<.1
Idaho:	Boise	1	<.1	<.1	<.1
	Idaho Falls	1	<.1	<.1	<.1
	Preston	1	.1	.1	.1
	Twin Falls	1	<.1	<.1	<.1
Iowa:	Iowa City	1	<.1	<.1	<.1
	Sioux City	1	<.1	<.1	<.1
Kans:	Dodge City	1	<.1	<.1	<.1
La:	Monroe	1	<.1	<.1	<.1
	New Orleans	1	<.1	<.1	<.1
Minn:	Minneapolis	1	<.1	<.1	<.1
Mo:	Clayton	1	<.1	<.1	<.1
	Joplin	1	<.1	<.1	.1
Nebr:	North Platte	1	<.1	<.1	<.1
Nev:	Alamo	30	.1	<.1	.1
	Austin	20	.1	<.1	.1
	Battle Mountain	1	<.1	<.1	<.1
	Beatty	30	.3	<.1	.1
	Blue Eagle Ranch (Currant)	30	<.1	<.1	.1
	Blue Jay	30	.1	<.1	.1
	Caliente	30	.1	<.1	.1
	Currant Ranch	30	<.1	<.1	.1
	Currie	1	<.1	<.1	<.1
	Diablo	29	.2	<.1	.1
	Duckwater	17	.1	<.1	.1
	Elko	1	.1	.1	.1
	Ely	25	.2	<.1	.1
	Eureka	30	<.1	<.1	.1
	Fallini's Twin Springs Ranch	29	.1	<.1	.1
	Fallon	1	.1	.1	.1
	Frenchman Station	1	<.1	<.1	<.1
	Geyser Ranch	27	.1	<.1	.1
	Goldfield	29	<.1	<.1	.1
	Groom Lake	18	.1	<.1	.1
	Hiko	30	.1	<.1	.1
	Indian Springs	30	<.1	<.1	.1
	Las Vegas	18	.1	<.1	.1
	Lathrop Wells	30	<.1	<.1	.1
	Lida	30	<.1	<.1	.1
	Lovelock	1	<.1	<.1	<.1
	Lund	28	.1	<.1	.1
	Mesquite	30	<.1	<.1	.1
Nev:	Nyala	30	<.1	<.1	.1
	Pahrump	30	<.1	<.1	.1
	Pioche	28	.1	<.1	.1
	Reno	1	.1	.1	.1
	Round Mountain	28	.2	<.1	.1
	Scotty's Junction	29	<.2	<.1	.1
	Stone Cabin Ranch	30	<.1	<.1	.1
	Sunnyside	30	.1	<.1	.1
	Tonopah	30	.1	<.1	.1
	Tonopah Test Range	19	.1	<.1	.1
	Warm Springs	28	.1	<.1	.1
	Warm Springs Ranch	30	.1	<.1	.1
	Winnemucca	1	.1	.1	.1
Okla:	Muskogee	1	<.1	<.1	<.1
Oreg:	Burns	1	<.1	<.1	<.1
	Medford	1	<.1	<.1	<.1
S. Dak:	Aberdeen	1	<.1	<.1	<.1
	Rapid City	1	.1	.1	.1
Tex:	Abilene	1	<.1	<.1	<.1
	Amarillo	1	.1	.1	.1
	Austin	2	<.1	<.1	<.1
	Fort Worth	1	<.1	<.1	<.1
Utah:	Bryce Canyon	3	.1	<.1	.1
	Cedar City	25	.2	<.1	.1
	Delta	30	<.2	<.1	.1
	Dugway	1	<.1	<.1	<.1
	Enterprise	1	<.1	<.1	<.1
	Garrison	30	<.1	<.1	.1
	Logan	1	<.1	<.1	<.1

Table 2. Summary of gross beta radioactivity concentrations in air, September 1973 —continued

Location		Number of samples	Concentration (pCi/m³)		
			Maximum	Minimum	Average[a]
Utah:	Milford	29	.1	<.1	.1
	Monticello	1	<.1	<.1	<.1
	Parowan	1	.1	.1	.1
	Provo	1	<.1	<.1	<.1
	Salt Lake City	1	<.1	<.1	<.1
	St. George	29	.1	<.1	.1
	Vernal	1	<.1	<.1	<.1
Wash:	Seattle	1	<.1	<.1	<.1
Wyo:	Rock Springs	1	<.1	<.1	<.1
	Worland	1	<.1	<.1	<.1

Figure 3. NERC/LV Air Surveillance Network stations outside Nevada

Complete copies of this summary and listings of the daily gross beta and gamma spectrometry results are distributed to EPA Regional Offices and appropriate State agencies. Additional copies of the daily results may be obtained from the NERC-LV upon written request.

3. Canadian Air and Precipitation Monitoring Program,[3] September 1973

Radiation Protection Bureau
Department of National Health and Welfare

The Radiation Protection Bureau of the Canadian Department of National Health and Welfare monitors surface air and precipitation in connection with its Radioactive Fallout Study Program. Twenty-four collection stations are located at airports (figure 4), where the sampling equipment is operated by personnel from the Atmospheric Environment Service of the Department of the Environment. Detailed discussions of the sampling procedures, methods of analysis, and interpretation of results of the radioactive fallout program are contained in reports of the Department of National Health and Welfare (*1–5*).

A summary of the sampling procedures and methods of analysis was presented in the May 1969 issue of *Radiological Health Data and Reports*.

Surface air and precipitation data for September are presented in table 3.

[3] Prepared from information and data obtained from the Canadian Department of National Health and Welfare, Ottawa, Canada.

Table 3. Canadian gross beta radioactivity in surface air and precipitation, September 1973

Station	Number of samples	Air surveillance gross beta radioactivity (pCi/m³)			Precipitation measurements	
		Maximum	Minimum	Average	Average concentration (pCi/liter)	Total deposition (nCi/m²)
Calgary	5	0.02	0.01	0.01	27	0.8
Coral Harbour	4	.01	.01	.01	6	.3
Edmonton	5	.03	.01	.01	16	.6
Ft. Churchill	4	.01	.01	.01	7	.5
Fredericton	5	.02	.01	.01	3	.3
Goose Bay	2	.01	.01	.01	6	.1
Halifax	4	.03	.01	.02	6	.1
Inuvik	2	.02	.01	.02	29	.1
Montreal	4	.03	.01	.02	9	.8
Moosonee	3	.02	.01	.02	10	.6
Ottawa	NS				9	.7
Quebec	5	.02	.01	.02	6	.7
Regina	NS				9	.5
Resolute	4	.01	.01	.01	7	.3
St. John's Nfld.	1	.01	.01	.01	1	.2
Saskatoon	4	.03	.01	.02	18	.7
Sault Ste. Marie	5	.02	.01	.01	8	.4
Thunder Bay	4	.01	.01	.01	4	.6
Toronto	5	.03	.01	.02	11	.7
Vancouver	5	.01	.01	.01	9	.3
Whitehorse	5	.02	.01	.01	7	.5
Windsor	1	.01	.01	.01	7	.4
Winnipeg	5	.02	.01	.01	7	.6
Yellowknife	2	.02	.01	.02	33	.5
Network summary	84	0.03	0.01	0.01	11	0.5

NS, no sample.

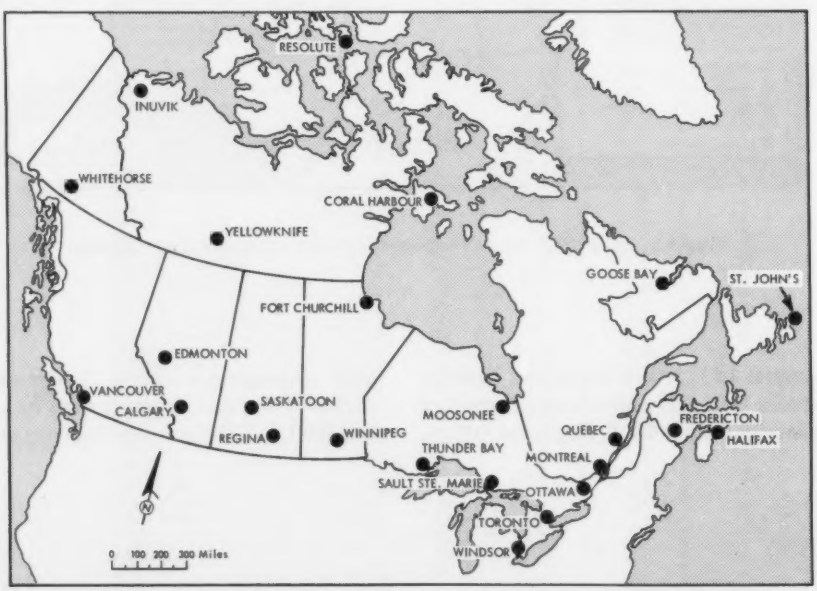

Figure 4. Canadian air and precipitation sampling stations

4. Pan American Air Sampling Program September 1973

Pan American Health Organization and U.S. Environmental Protection Agency

Gross beta radioactivity in air is monitored by countries in the Americas under the auspices of the collaborative program developed by the Pan American Health Organization (PAHO) and the Environmental Protection Agency (EPA) to assist PAHO-member countries in developing radiological health programs.

The air sampling station locations are shown in figure 5. Analytical techniques were described in the March 1968 issue of *Radiological Health Data and Reports*. The September 1973 air monitoring results from the participating countries are given in table 4.

Figure 5. Pan American Air Sampling Program stations

Table 4. Summary of gross beta radioactivity in Pan American surface air, September 1973

Station location		Number of samples	Gross beta radioactivity (pCi/m³)		
			Maximum	Minimum	Average [a]
Argentina	Buenos Aires	0			
Bolivia:	La Paz	0			
Chile:	Santiago	29	0.16	0.00	0.02
Colombia:	Bogota	20	.02	.00	.00
Ecuador:	Cuenca	16	.05	.00	.01
	Guayaquil	16	.05	.01	.02
	Quito	2	.04	.01	.03
Guyana:	Georgetown	0			
Jamaica:	Kingston	0			
Peru:	Lima	0			
Venezuela:	Caracas	7	.01	.00	.01
West Indies:	Trinidad	8	.14	.03	.06
Pan American summary		98	0.16	0.00	0.02

[a] The monthly average is calculated by weighting the individual samples with length of sampling period. Values less than 0.005 pCi/m³ are reported and used in averaging as 0.00 pCi/m³.

5. California Air Sampling Program September 1973

Radiologic Health Section California Department of Health

The Radiologic Health Section of the California Department of Health with the assistance of several cooperating agencies and organizations operates a surveillance system for determining radioactivity in airborne particulates. The air sampling locations are shown in figure 6.

All air samples are sent to the Sanitation and Radiation Laboratory of the State Department of Health where they are analyzed for their radioactive content.

Airborne particles are collected by a continuous sampling of air filtered through a 47 milli-

Figure 6. California air sampling program stations

meter membrane filter, 0.8 micron pore size, using a Gast air pump of about 2 cubic feet per minute capacity, or 81.5 cubic meters per day. Air volumes are measured with a direct reading gas meter. Filters are replaced every 24 hours except on holidays and weekends. The filters are analyzed for gross alpha and beta radioactivity 72 hours after the end of the collection period. The daily samples then are composited into a monthly sample for gamma spectroscopy and an analysis for strontium-89 and strontium-90. Table 5 presents the monthly gross beta radioactivity in air for September. The monthly sample results are presented quarterly.

Table 4. Gross beta radioactivity in California air September 1973

Station location	Number of samples	Gross beta radioactivity (pCi/m³)		
		Maximum	Minimum	Average
Bakersfield	28	0.72	0.05	0.15
Barstow	30	.44	.02	.17
Berkeley	30	.15	.00	.04
El Centro	28	.20	.03	.12
Eureka	25	.14	.00	.03
Fresno	28	1.21	.04	.24
Los Angeles	28	.17	.01	.05
Redding	27	.45	.03	.13
Sacramento	28	.42	.01	.10
Salinas	28	3.31	.00	.34
San Bernardino	28	.27	.01	.09
San Diego	28	.58	.02	.10
San Luis Obispo	28	.28	.02	.09
Santa Rosa	30	.48	.00	.07
Summary	394	3.31	0.00	0.12

REFERENCES

(*1*) BIRD, P. M., A. H. BOOTH, and P. G. MAR. Annual report of 1959 on the Radioactive Fallout Study Program, CNHW–RP–3. Department of National Health and Welfare, Ottawa, Canada (May 1960).

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SECTION IV. OTHER DATA

This section presents results from routine sampling of biological materials and other media not reported in the previous sections. Included here are such data as those obtained from human bone sampling, Alaskan surveillance, and environmental monitoring around nuclear facilities.

Environmental Levels of Radioactivity at Atomic Energy Commission Installations

The U.S. Atomic Energy Commission (AEC) receives from its contractors annual reports on the environmental levels of radioactivity in the vicinity of major Commission installations. The reports include data from routine monitoring programs where operations are of such a nature that plant environmental surveys are required.

Releases of radioactive materials from AEC installations are governed by radiation standards set forth by AEC's Division of Operational Safety in directives published in the "AEC Manual." [1]

A summary of the environmental radioactivity data follow for the Knolls Atomic Power Laboratory-Windsor Site and the Portsmouth Area Gaseous Diffusion Plant.

[1] Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation," contains essentially the standards published in Chapter 0524 of the AEC Manual.

1. Knolls Atomic Power Laboratory-Windsor Site[2] (S1C Prototype Reactor Facility) January–December 1971

General Electric Company
Windsor, Conn.

The Windsor Site of the Knolls Atomic Power Laboratory includes the S1C prototype nuclear power plant facility which is located on a 10-acre plot of government-owned property in Windsor, Conn. The facility is used primarily to train personnel in the operation of nuclear power plants. Airborne effluents are filtered and discharged through monitored stacks; liquid effluents are processed and monitored before discharge to the Farmington River.

Airborne radioactivity

Effluents from site locations where particulate airborne radioactivity could be generated are directed through ducts to discharge stacks, which are monitored for airborne radioactivity on a continuous basis. The main stack is monitored by a fixed filter sampling system; the filter is changed weekly and analyzed by radiation counting equipment calibrated to a cobalt-60 standard. The radiochemistry laboratory stack is monitored by a continuous moving filter detector, with continuous readout on a moving chart.

During 1971, the total particulate activity released from the Windsor Site was less than 54 microcuries. The volume of air discharged to the atmosphere was 1.7×10^8 m^3, giving an average value of 0.318 pCi/m^3 over the year. This is <0.1 percent of the applicable Atomic Energy Commission Concentration Guide.[3] The only gaseous radionuclide of concern, argon-41, has a half life of less than 2 hours and does not build up in the environment. It is concluded that the small quantity and low concentration

[2] Summarized from Knolls Atomic Power Laboratory, Windsor Site, Annual Environmental Radioactivity Monitoring Report, January–December 1971.

[3] AEC Manual, Chapter 0524 and Handbook, "Prevention, Control and Abatement of Air and Water Pollution."

of airborne activity released from the Windsor Site in 1971 had no significant effect on the environment.

Farmington River water samples

Liquid effluents released from the Windsor Site are collected, sampled, and processed in retention tanks prior to release to the Farmington River. Each retention tank is sampled at the start, middle, and just prior to end of discharge. The total activity discharged in the liquid waste during 1971 was <270 microcuries. This results in an average concentration of <140 pCi/liter at the point of discharge, which is <0.45 percent of the appropriate AEC standard.

Water samples were taken in the Farmington River at three locations (figure 1). These samples, which are collected quarterly, were obtained in 1 liter bottles and analyzed with a gamma spectrometer calibrated to cobalt-60 standards. The activity is reported as "gross gamma" based on the cobalt-60 calibration.

Results of the Farmington River water sampling for calendar year 1971 are shown in table 1. No indication of activity in the cobalt-60 energy range was detected. The cobalt-60 energy range minimum detectable activity values are listed for information. The average "gross gamma" activity of the Farmington River water samples was <120 pCi/liter, which is <0.4 percent of the AEC standard.

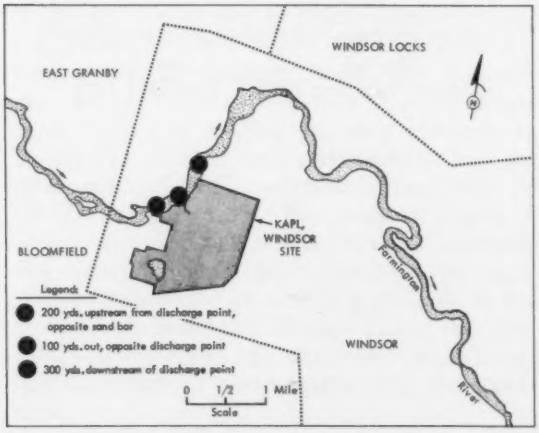

Figure 1. Environmental monitoring locations, KAPL-Windsor site (S1C Prototype)

Table 1. Results of Farmington River water sample analyses, 1971

Sampling location	Number of samples	Gross gamma concentration [a] (pCi/liter)			Cobalt-60 energy range average [b] (pCi/liter)
		Maximum	Minimum	Average	
Upstream	[c] 3	190	<88	<120	<200
Opposite	[c] 3	160	<88	<110	<200
Downstream	[c] 3	<150	<88	<110	<200

[a] The minimum detectable average gross gamma concentration was 120 pCi/liter.
[b] The minimum detectable average cobalt-60 energy range gamma concentration was 200 pCi/liter.
[c] Samples not obtained during first quarter due to ice on river.

It is concluded that the small quantity and low concentration of activity in liquids released from the Windsor Site in 1971 had no significant effect on the environment.

Farmington River bottom sediment samples

Sediment samples were taken from the Farmington River bottom at three locations (figure 1). These samples were obtained by the use of a "clam shell" type dredge and represent a depth of collection of 2.5 cm. Specific gravity at standard dry weight for these samples is 1.5 g/cm^3. The quarterly sediment samples were analyzed by a gamma spectrometer calibrated with cobalt-60 standards.

The sampling locations may be described as follows:

1. Approximately 180 meters upstream from the discharge point, in the middle of the river.
2. Middle of river, opposite the discharge point.
3. Approximately 275 meters downstream from the discharge point, in the middle of the river.

The results of Farmington River sediment sampling for calendar year 1971 are shown in table 2. Cobalt-60 analyses of the river sediment samples were all less than minimum detectable activity with the exception of one sample obtained during the second quarter. A positive indication of cobalt-60 energy range activity was observed at sample location 2 during the second quarter only, when 7.3 pCi/g was measured. This concentration was less than one-third of the natural activity in the river bottom sediment (potassium-40, radium, thorium, etc.) and less than one-fourth of the AEC

standard. The generally low levels of activity in the river bottom sediment and the insignificant difference between upriver and downriver samples show that Windsor Site operations are effective in protecting the environment and the public health.

Table 2. Results of Farmington River sediment sample analyses, 1971

Sampling location	Number of samples	Gross gamma concentration [a] (pCi/g wet weight)			Cobalt-60 energy range average [b] (pCi/g wet weight)
		Maximum	Minimum	Average	
Upstream	[c] 3	2.3	2.2	2.3	0.36
Opposite	[c] 3	8.7	1.6	4.2	[d] 2.7
Downstream	[c] 3	2.2	1.9	2.1	[d] .45

[a] The minimum detectable average gross gamma concentration was 0.24 pCi/g wet weight.
[b] The minimum detectable average cobalt-60 energy range gamma concentration was 0.36 pCi/g wet weight.
[c] Samples not obtained during first quarter due to ice on river.
[d] Includes effect of potassium-40 in the samples.

Perimeter fence monitoring for penetrating radiation

Beta-gamma film badges are posted on the site perimeter fence at eight locations. The film is changed and evaluated monthly according to standard techniques used for personnel monitoring film. The minimum dose measurable by the above method is 10 mrem per month. Each of the 96 perimeter films indicated a dose rate of 10 mrem/month. Therefore, the average annual dose rate was 120 mrem/year, which is the natural radiation level for this geographic location. It is concluded that Windsor Site operation did not significantly contribute to the natural background radiation of the surrounding area.

Conclusions

Results of the environmental monitoring conducted by KAPL indicates that the Windsor Site operations have met all the federal regulations pertaining to the AEC standards. All environmental samples are analyzed for cobalt-60 activity since this is the predominant and most restrictive radionuclide present in the effluents discharged.

The average gross gamma activity in the Farmington River water at the three sampling points was <120 pCi/liter (the minimum detectable concentration) and <0.4 percent of the applicable AEC standards. No positive indication of cobalt-60 activity was detected. The average gross gamma activity of the Farmington River bottom sediment samples was 2.9 pCi/g, which is <10 percent of the applicable AEC standards.

The airborne radioactivity concentration discharged to the environment during calendar year 1971 was <0.1 percent of that permitted by AEC standards. Environmental radiation monitoring with film dosimeters at the site perimeter indicated that the environmental dose rate was <120 mrem/year, which is the natural radiation level for this geographic location.

It is concluded that Windsor Site operations in calendar year 1971 did not significantly effect the local or regional environmental radiation levels.

Previous coverage in *Radiation Data and Reports:*

Period	Issue
January–December 1970	November 1972

2. Portsmouth Area Gaseous Diffusion Plant[3] January–December 1971

Goodyear Atomic Corporation
Piketon, Ohio

The Portsmouth Gaseous Diffusion Plant is owned by the U.S. Atomic Energy Commission and is operated by Goodyear Atomic Corporation, a subsidiary of the Goodyear Tire and Rubber Company. It is located in thinly populated rural Pike County, Ohio. The principal process in the plant is the separation of uranium isotopes through gaseous diffusion. Ancillary processes include feeding and removal of materials from the primary process; treatment of water for both sanitary and cooling purposes; decontamination of equipment removed from the plant for maintenance or replacement; recovery of uranium from various waste materials, such as decontamination solutions and laboratory wastes; and treatment of sewage wastes.

In the operation of a gaseous diffusion plant, as in the operation of any industrial plant, waste materials necessarily are generated as by-products of the industrial processes. Since there is an ever present possibility that the wastes may contain environmental pollutants, including radioactive materials, the effluents from the various excessive quantities of pollutants and radioactive materials are not discharged into the environment. Where necessary, treatment is provided to reduce concentrations to acceptable limits before the materials are discharged. In addition, water, air, and soil samples are collected routinely at many points both inside and outside the plant property to assure that the ambient environment has not been polluted with radioactive materials or other contaminants. The map in figure 1 shows the locations where samples normally are collected. This report describes the various environmental standards applicable to the Portsmouth Gaseous Diffusion Plant; the sampling, monitoring, and analytical procedures; and the extent of conformance with the standards.

[3] Data summarized from "Portsmouth Gaseous Diffusion Plant Environmental Monitoring Report—1971" (GAT–706).

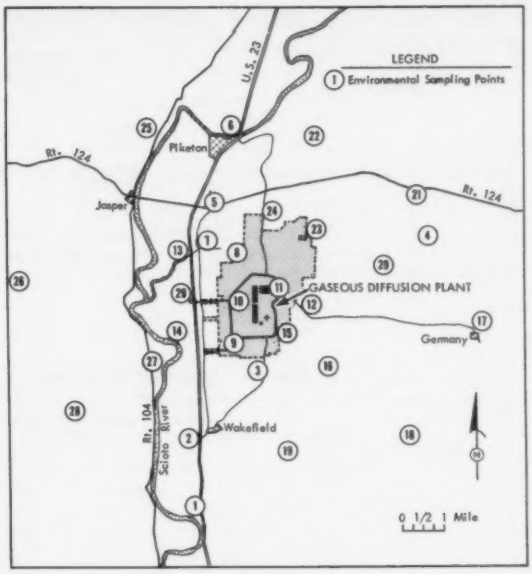

Figure 2. Sampling Locations, Portsmouth Area Gaseous Diffusion Plant

Since uranium and its daughter product, thorium-234, are the only radioactive elements present in significant quantities at the Portsmouth Gaseous Diffusion Plant, it is assumed that the measured gross alpha radioactivity is due to uranium of various enrichments and the beta-gamma radiation emanates from the thorium-234.

Air samples are collected three times each week at four locations, identified as points 3, 12, 24, and 29 on the map. Each radioactivity sample, consisting of approximately 28 cubic meters of air, is passed through a Whatman #41 filter paper at about 0.56 cubic meter per minute. The material collected on the filter paper is analyzed for gross alpha and gross beta-gamma radioactivities. Average alpha and beta-gamma radioactivity concentrations are summarized in table 3.

Two procedures are used for water sampling. One-half gallon samples are taken monthly from the Scioto River and its tributaries, Little Beaver Creek, Big Beaver Creek, and Big Run. Composite samples are collected continuously (or at specific intervals) from the three principal drainage ditches serving the plant; sampling

Table 3. Radioactivity in air, Portsmouth Plant, January-December 1971

Location	Number of samples	Alpha radioactivity concentration (fCi/m³)		Average as a percent of AEC standards[a]	Beta-gamma radioactivity concentration (pCi/m³)		Average as a percent of AEC standards[a]
		Maximum	Average		Maximum	Average	
3	143	530±270	40±10	0.88	1.66±0.42	0.40±0.07	0.04
12	144	500±250	40±10	.88	2.11± .53	.44± .08	.04
24	143	530±270	50±10	1.20	2.03± .52	.43± .08	.04
29	138	480±240	50±10	1.15	1.93± .48	.43± .08	.04

[a] The AEC radiation protection standard for alpha radioactivity in air—4 pCi/m³; beta-gamma radioactivity—1 nCi/m³; sensitivity of analysis for both alpha and beta radioactivity is 16.1 fCi/m³.

Table 4. Radioactivity in water, Portsmouth Plant, January-December 1971

Location	Number of samples	Water flow rate (m³/s)	Alpha radioactivity concentration (pCi/liter)		Average as a percent of AEC standards	Number of samples	Beta-gamma radioactivity concentration (pCi/liter)		Average as a percent of AEC standards
			Maximum	Average			Maximum	Average	
1	12	201.9	4.1± 2.7	2.5± 2.4	0.008	12	30± 27	12± 8	0.06
2	12	[b]	63.0±10.7	10.1±11.9	.03	12	76± 41	10± 14	.05
3	31	.011	4.5± 2.7	1.1± .5	.004	32	40± 30	9± 4	.04
4	11	[b]	13.5± 4.5	2.3± 3.1	.008	11	58± 36	14± 11	.07
5	12	[b]	4.5± 2.7	2.7± 2.2	.009	12	32± 27	9± 7	.04
6	41	201.9	40.5± 8.5	3.6± 2.7	.01	41	207± 68	10± 10	.05
7	15	.122	207 ±18.6	84.8±27.0	.28	15	1 755±190	806±367	4.03
8	15	.122	121.5±14.6	69.8±14.7	.23	15	1 634±200	563±252	2.82
10	30	.011	9.0± 4.1	2.5± .9	.008	31	90± 45	12± 7	.06
11	30	.051	333 ±23.3	136.2±34.8	.45	31	8 780±439	922±711	4.61
12	11	[b]	3.2± 2.3	1.1± 1.0	.004	11	27± 25	8± 5	.04
13	12	[b]	81.0±12.2	22.8±13.8	.08	12	346± 87	140± 73	.70
14	12	201.9	9.0± 4.1	3.5± 1.8	.01	12	76± 41	17± 14	.08

[a] The AEC radiation protection standard for alpha radioactivity in water—30 nCi/liter; beta-gamma radioactivity—20 nCi/liter; sensitivity of analysis, alpha radioactivity-0.5 pCi/liter; beta radioactivity-5.0 pCi/liter.
[b] Not measured.

locations are identified on the map as points 3, 10, and 11. The composite samples are collected in 55-gallon drums. Once each week, the water in the drums is mixed thoroughly, a one-half-gallon sample is withdrawn for analysis, and the drum is drained, cleaned, and installed again in the collection system. The one-half gallon samples are analyzed for gross alpha and beta-gamma radioactivity. Radioactivity in water samples are shown in table 4.

External gamma radiation levels are measured routinely at locations 3, 12, 24, and 29 to serve as indicators of background radiation. Measurements are made three times each week with a calibrated Geiger-Muller tube at 3 feet above ground level. Average background rate for 1971 was 11.8 μR/h, which is not significantly different from the 1954 average rate, 11.9 μR/h. Background radioactivity is shown in table 5.

Table 5. Background radiation, Portsmouth Plant January-December 1971

Location	Number of samples	Exposure rate [a] (μR/h)		Exposure [b] (mR)
		Maximum	Average	
3	131	22.1± 3.3	11.2±0.4	98.1± 3.5
12	135	18.6± 2.8	10.4± .4	89.4± 3.4
24	136	78.8±11.8	13.5±1.6	119.1±14.1
29	130	25.7± 3.9	12.1± .5	106.0± 4.3

[a] Open-shield Geiger tube 3 feet above ground; limit of sensitivity—0.1 μR/h. Average background exposure rate for the Portsmouth Gaseous Diffusion Plant in 1954 was 11.9 μR/h, not significantly different from present rates.
[b] Total for the year.

The data presented in the tables show clearly that radioactivity contamination of the environment is not a problem at the Portsmouth Gaseous Diffusion Plant. Maximum concentrations of alpha radioactivity in air, beta-gamma in air, alpha in water, and beta-gamma in water during 1971 were only 13 percent, 0.2 percent, 1.1 percent, and 44 percent of the AEC standards,

respectively. None of the averages were greater than 5 percent of the AEC standards. As may be seen in table 4, the only significant concentrations of radioactivity in water were found in samples taken downstream from the X–701B holding pond, which receives all the radioactive decontamination solutions from the plant. In addition, the background radiation is essentially the same as it was in 1954. Obviously, there is no widespread radioactive contamination occurring.

Previous coverage in *Radiation Data and Reports:*

Period	Issue
January–June 1971	February 1972

Reported Nuclear Detonations, December 1973

(Includes seismic signals presumably from foreign nuclear detonations)

The U.S. Atomic Energy Commission announced that the United States recorded seismic signals, presumably from a Soviet underground nuclear explosion on December 14, 1973 at approximately 2:47 a.m. (EST). The signals originated at the Semipalatinsk nuclear test area and were equivalent to those of an underground nuclear explosion in the yield range of 200 kilotons to 1 megaton.

No nuclear detonations by the United States were reported by the U.S. Atomic Energy Commission for December 1973.

Not all of the nuclear detonations in the United States are announced immediately, therefore, the information in this section may not be complete. A complete list of announced U.S. nuclear detonations may be obtained upon request from the Division of Public Information, U.S. Atomic Energy Commission, Washington, D.C. 20545.

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January 1974

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